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# Analysis of Skilled Talent Demand in Higher Vocational Education and Collaborative Training Mechanisms under the Emerging Low-Altitude Economy Model

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**Abstract: This study investigates the intrinsic mechanisms and outcomes of the coordinated development between Zhejiang Province's aviation industry and vocational education amid the macro-context of low-altitude airspace liberalization. Leveraging the SMF Formation model, the research systematically elucidates the internal logic of aviation industry chain expansion. Applying the SCP paradigm, it comprehensively examines the dynamic evolution of the aviation sector's competitive landscape. Additionally, the VEC model is employed to identify pathways for deeper industry-education integration. Through in-depth case analyses of leading examples—including Shandong Taikoo, Hangzhou YTO Cargo Airlines, and Xunyu Network—supported by empirical data, the study demonstrates how low-altitude airspace liberalization contributes to structural optimization in the aviation industry, enhanced market competitiveness, and strengthened industry-education collaboration. Finally, the research proposes actionable recommendations to further integrate Zhejiang's aviation sector with vocational education. These insights not only offer theoretical and practical value for regional economic sustainability but also establish a replicable framework for aviation-education synergy at the national level.**

**Keywords: Low Altitude Opening; Aviation Industry; Vocational Education; SMF Formation; SCP Paradigm; VEC Model**

## 1. Introduction

Driven by the ongoing implementation of national low-altitude airspace liberalization policies, China's aviation industry has entered an unprecedented period of prosperity. The opening of low-altitude airspace has not only significantly spurred the rapid growth of the general aviation market but also invigorated the entire industrial chain, including aviation manufacturing, maintenance, and service sectors, injecting robust momentum into the transformation and upgrading of the economic structure. As a pivotal economic hub in the eastern coastal region, Zhejiang Province has demonstrated remarkable advantages and immense potential in the rise of the aviation industry, leveraging its unique geographical location, solid manufacturing foundation, and optimized business environment. However, the rapid expansion of the aviation industry has also imposed increasingly stringent demands on the professional talent pool, highlighting the urgency and importance of fostering coordinated development between vocational education and the industry.

## 2. Research Background

In recent years, with the gradual liberalization of low-altitude airspace, the synergistic development of the low-altitude economy and the aviation industry has become a focal point of global academic and industrial attention. Scholars worldwide have conducted extensive and in-depth research on the definition, development pathways, policy environment, and interactive relationship between the low-altitude economy and vocational education.

International Research Status: International scholars have pioneered research in the field of the low-altitude economy, accumulating a wealth of theoretical and practical experience. Their studies have primarily focused on the mechanisms through which the low-altitude economy contributes to economic growth, the driving effects of technological innovation on industrial development, and the critical role of policy guidance in promoting the sustainable development of the low-altitude economy. In several Western countries, the establishment of comprehensive low-altitude regulatory systems and policy frameworks has effectively facilitated the popularization and growth of general aviation, fostering a robust aviation culture and forming a mature and stable general aviation industrial chain.

Domestic Research Status: In China, the low-altitude economy, as an emerging strategic industry, is attracting widespread attention from both academia and industry. Research topics extensively cover various dimensions, including the industrial value assessment, development pathway planning, and policy environment optimization of the low-altitude economy. Particularly in economically developed regions such as Zhejiang, local governments have actively responded by introducing a series of policy measures to accelerate the development of the low-altitude economy. Scholars, leveraging regional characteristics, have deeply analyzed the intrinsic logic of the coordinated development between the low-altitude economy and regional economies, proposing numerous forward-looking strategic recommendations. Additionally, domestic scholars have innovatively employed analytical tools such as the SCP paradigm and VEC model to meticulously dissect the competitive structure, market behavior, and performance of the low-altitude economy, providing solid theoretical foundations and practical guidance for the formulation and implementation of industrial policies.

Specifically, Zhang et al. employed the SCP paradigm to analyze the digital-intelligent operations of the new retail tea beverage industry, revealing the role of digital-intelligent technologies in enhancing supply chain efficiency, market sensitivity, and business sustainability. Their work provides a reference framework for market analysis and strategy optimization in this study. [1] Song and Chen utilized the VEC model to conduct an in-depth analysis of the factors influencing the national carbon market price. Their research methods and conclusions offer valuable insights for exploring the interaction between policies and markets in the coordinated development of the aviation industry and vocational education. [2] Wang and Chen demonstrated the application of Word2Vec and decision trees in fault localization. Although their field differs from this study, their innovative technical methods provide inspiration for data analysis and model construction in this research. [3] Wang employed the T-LDA2vec model for topic mining and evolution analysis of information literacy education in university libraries. The methodological rigor and data processing innovation in their study offer valuable references for exploring theme evolution and trend prediction in the coordinated development of the aviation industry and vocational education. [4] Xie conducted a detailed analysis of the factors influencing the text classification effectiveness of Word2Vec. Their findings provide guidance for model selection and parameter setting in this study when utilizing text data to research the coordinated development of the aviation industry and vocational education. [5] Ma et al. conducted an in-depth study on the high-quality development of China's general aviation from the perspectives of policy tools and industrial chain coordination. Their research framework and conclusions offer an important theoretical foundation and practical reference for this study in exploring the coordinated development of the aviation industry and vocational education under the backdrop of low-altitude airspace liberalization policies. [6] Hu et al. used the LDA-Word2vec method to identify the evolution and hotspots of machine learning research topics in the field of library and information science. Their research methods and results provide significant reference value for identifying key themes and evolutionary trends in the coordinated development of the aviation industry and vocational education. [7] Wang et al. studied the high-quality development of Hunan's general aviation industry under the context of comprehensive low-altitude airspace liberalization. Their regional perspective and policy recommendations offer comparative insights and strategy formulation references for this study in exploring the coordinated development of Zhejiang's aviation industry and vocational education. [8] Zhao analyzed China's express delivery industry based on the SCP paradigm. Their research methods and conclusions provide beneficial references and comparative perspectives for this study in applying the SCP paradigm to dissect the competitive landscape of the aviation industry. [9] Bai in the China Aviation News, proposed suggestions for developing the low-altitude economy and creating a "new growth pole" in the aviation sector. Their viewpoints align closely with the background of this study, providing important policy direction and practical context for exploring the coordinated development of the aviation industry and vocational education under low-altitude airspace liberalization policies. [10]

Research Gaps and Limitations: Although scholars both domestically and internationally have achieved significant progress in the field of low-altitude economy and aviation industry synergy, several research gaps and limitations remain. Current studies predominantly focus on the macro level, lacking in-depth exploration of micro-level behavioral mechanisms, such as the specific impacts of the low-altitude economy on corporate decision-making, technological innovation pathways, and vocational education systems [11]. Research on the intrinsic mechanisms, influencing factors, and optimization strategies for the coordinated development of the low-altitude economy and vocational education is still relatively underdeveloped. In the face of new business models and paradigms brought about by technological advancements and market changes, there is an urgent need to capture and respond to these emerging trends, formulating scientifically sound policy measures and development strategies. This remains a critical issue to be addressed in current research [12].

This study provides a profound analysis of the strategic significance and practical demands for the coordinated development of Zhejiang's aviation industry and vocational education under the backdrop of low-altitude airspace liberalization policies. It aims to: (1) reveal the reshaping effects of low-altitude airspace liberalization policies on Zhejiang's aviation industry structure and the corresponding changes in talent demand; (2) assess the current status and challenges of the vocational education system in adapting to the rapid development of the aviation industry; and (3) construct a strategic framework and pathway planning to promote the synergistic development of the two. The core research questions focus on: how low-altitude airspace liberalization drives the upgrading of the aviation industry structure; how vocational education can efficiently meet the growing talent demands; and how to overcome collaborative barriers to establish a robust long-term cooperation mechanism, providing a replicable model for coordinated development in Zhejiang and beyond.

Innovation of the Research: The innovation of this study lies in addressing the topic of "Coordinated Development of Zhejiang's Aviation Industry and Vocational Education Driven by Low-Altitude Airspace Liberalization" by employing the SCP paradigm and VEC model to fill existing research gaps [13]. Through micro-level behavioral analysis, it reveals the profound impact mechanisms of the low-altitude economy on corporate decision-making, technological innovation, and vocational education systems. The study constructs a theoretical framework for coordinated development, exploring the interaction and synergy mechanisms between the two [14]. It proposes evidence-based policy recommendations and development strategies to support local government decision-making. Additionally, it conducts forward-looking research on the influence of emerging business models and paradigms on vocational education and regional economies, providing direction for future development.

Research Methodology: As illustrated in Figure 1, this study adopts a diversified and systematic research strategy to comprehensively and deeply analyze the complex issue of coordinated development between Zhejiang Province's aviation industry and vocational education under the backdrop of low-altitude airspace liberalization policies. The specific methods encompass theoretical analysis, empirical research, model construction and simulation, as well as policy recommendations and strategy formulation based on these analyses. The details are as follows:

1) Theoretical Analysis:

Industrial Economics Theory (IET): Utilizing market segmentation and industrial chain theory, this study analyzes the impact of low-altitude airspace liberalization policies on the expansion of the aviation industry chain and the emergence of new market segments (e.g., drone services, aviation tourism). The SCP paradigm is employed to explore the evolution of market competition patterns and corporate strategy adjustment pathways. By integrating resource allocation and innovation theory, a VEC model is constructed to examine the precise alignment mechanism between vocational education and the aviation industry, as well as its role in

promoting industrial upgrading.
Educational Economics Theory (EET): Cost-benefit analysis (CBA) is used to quantify the investment efficiency of vocational education. Human capital theory (HCT) and IOHS theory are applied to explain how vocational education drives aviation industry upgrading by optimizing human capital structure.

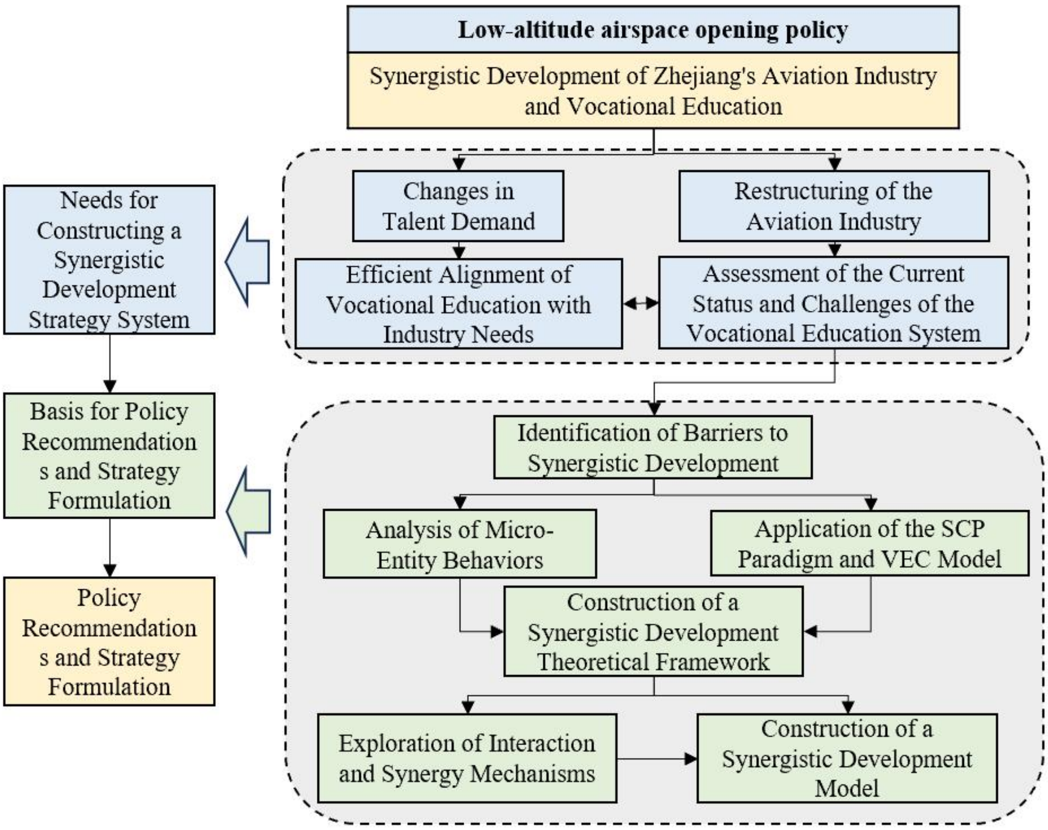


**Figure 1. Research Framework Diagram**

2) Empirical Research:
Case Studies: Representative aviation enterprises and vocational education institutions in Zhejiang Province are selected. Empirical data is collected through in-depth interviews and questionnaires to analyze their actual collaborative models and outcomes under low-altitude airspace liberalization policies.
Data Statistics and Analysis: Statistical software is used to perform descriptive statistics, correlation analysis, and regression analysis on the collected data, revealing the intrinsic relationships among variables and their impact on coordinated development.
3) Model Construction and Simulation:
Coordinated Development Model: A model incorporating policy, education systems, industrial development needs, and talent supply is constructed. Through quantitative analysis and case validation, the interaction mechanisms among these elements are explored.
Dynamic Evolution Model: Based on system dynamics, the dynamic process of coordinated development between the aviation industry and vocational education is simulated. Different scenarios are set to predict future trends, providing a forward-looking perspective for policy formulation. Additionally, simulation technology is used to evaluate policy effectiveness, offering a basis for policy optimization.
4) Policy Recommendations and Strategy Formulation:
Building on the above research findings, targeted policy recommendations and implementation plans are proposed to address the challenges in coordinated development, promote the deep integration and synergy between the aviation industry and vocational education, and provide scientific evidence and decision-making support for policymakers.

## 3. Theoretical Foundations

### 3.1 Industrial Economics Theory (IET)

In the context of globalization and low-altitude airspace liberalization, Industrial Economics Theory (IET) serves as a core framework for analyzing industrial structure, market behavior, and performance, providing a solid theoretical foundation for understanding the dynamic changes in Zhejiang Province's aviation industry. Specifically, IET profoundly influences the comprehension of aviation industry transformation under low-altitude airspace liberalization policies through the following key aspects:

1) Industrial Chain Extension and Segmented Market Formation (SCM & SMF)

Low-altitude airspace liberalization policies act as a powerful driving force, propelling the aviation industry chain (Supply Chain Management, SCM) to extend both upstream and downstream. Utilizing the market segmentation theory (Segmentation Market Formation, SMF) within IET, the formation mechanisms of emerging segmented markets (e.g., drone services, aviation tourism) can be analyzed. These segmented markets not only broaden the application scope of the aviation industry but also provide new directions for talent cultivation in vocational education.

2) Changes in Market Competition Patterns (MCP)

Low-altitude airspace liberalization has intensified competition within the aviation industry and introduced new market participants. The competition theory (Market Competition Pattern, MCP) in industrial economics helps analyze changes in corporate strategies, market structures, and performance during this process. The SCP (Structure-Conduct-Performance) paradigm can be applied to study how aviation enterprises enhance their competitiveness by adjusting strategies and optimizing resource allocation following low-altitude airspace liberalization.

3) Vocational Education and Industry Collaboration (VEC)

Vocational education plays a pivotal role in optimizing resource allocation (Resource Allocation, RA), promoting technological innovation (Technological Innovation, TI), and enhancing industrial competitiveness (Industrial Competitiveness, IC). By integrating resource allocation theory and innovation theory within IET, vocational education, through the VEC model, precisely aligns with the talent demands of the aviation industry, cultivating versatile professionals with innovative capabilities and practical experience. This synergy not only improves the alignment between talent and industry needs but also drives the transformation and upgrading of the aviation industry.

### 3.2 Educational Economics Theory (EET)

Educational Economics Theory plays a pivotal role in assessing the economic value and social benefits of vocational education in cultivating aviation talent. EET not only provides a framework for a deeper understanding of the relationship between educational investment and returns but also enhances the scientific rigor and precision of this evaluation process through a series of mathematical tools and methods.

Cost-Benefit Analysis (CBA) is one of the core methodologies within EET. It employs mathematical formulas to quantify the inputs (e.g., teaching facilities, faculty resources, student tuition) and outputs (e.g., student employment rates, salary levels, economic contributions to the aviation industry) of vocational education in the process of cultivating aviation talent. Specifically, CBA can be expressed as:

$$textNetBenefit = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t} \quad (1)$$

Where:

- *Bt* represents the benefits in year *t*,
- *Ct* represents the costs in year *t*,
- *r* is the discount rate, and
- *n* is the time horizon of the analysis.

This formula assists decision-makers in evaluating the long-term economic value of vocational education programs, determining whether they are worthy of investment.

### 3.3 Human Capital Theory (HCT)

Human Capital Theory (HCT) explicitly identifies high-quality talent as a critical driver of economic growth and industrial upgrading. Particularly in the aviation industry, which is characterized by high technology, high risk, and high added value, the demand for talent extends beyond the mastery of professional knowledge to include innovative capabilities, extensive practical experience, and a broad international perspective. Such versatile aviation professionals represent the "critical human capital" emphasized in HCT, playing an irreplaceable role in industrial development.

Integrating the latest industrial economics theories, particularly the "Industrial Upgrading and Human Capital Structure Optimization Theory" (IOHS), the value of human capital in the aviation industry can be further refined. IOHS theory posits that industrial upgrading is not merely the iteration of technology and products but also the optimization and upgrading of human capital structure. Mathematically, this can be expressed through the following simplified model:

$$HCS_{\text{optimal}} = f(T, K, P) \qquad (2)$$

The optimal human capital structure $HCS_{\text{optimal}}$ can be expressed as a function of technological advancement (T), knowledge capital (K), and personnel quality (P).

In the context of the aviation industry:

Technological Advancement (T) is reflected in the application of new aircraft models, materials, and technologies.

Knowledge Capital (K) encompasses intangible assets such as patents and scientific research achievements.

Personnel Quality (P) is directly related to individuals' professional skills, innovative capabilities, and international perspectives.

The deep integration of vocational education and the aviation industry enhances personnel quality (P), thereby optimizing the overall human capital structure. This process not only improves the direct production efficiency and innovation capabilities of the aviation industry but also drives the coordinated development of other related industries through the **spillover effect**, promoting the overall industrial upgrading of the regional economy. Specifically, the systematic and practice-oriented training provided by vocational education effectively shortens the transition period from "student" to "high-skilled labor," enabling talents to quickly adapt to market demands and become a driving force for industrial development.

## 4. Analysis of the Coordinated Development Mechanism Driven by Low-Altitude Airspace Liberalization

### 4.1 Exploration of the Synergistic Mechanism between Industrial Chain Extension and Segmented Markets

Driven by robust policy support, the aviation industry chain in Zhejiang Province has demonstrated significant extension trends, with low-altitude airspace liberalization policies playing a pivotal role. This policy orientation has propelled the industry chain to expand both upstream and downstream, constructing a more comprehensive and interconnected industrial ecosystem. Specifically:

Upstream: Key areas such as the research and manufacturing of high-performance engines and advanced aviation materials have been significantly strengthened, laying a solid technological foundation.

Midstream: The service capabilities in aircraft assembly, maintenance, and modification have been elevated, fostering the rapid development of supporting industries such as aviation logistics and aviation finance.

Downstream: The market has continuously expanded, with emerging consumer sectors like aviation tourism and private aviation breaking new ground and significantly broadening market boundaries.

This process not only enhances the resilience and stability of the industrial chain but also provides vocational education with diversified, high-quality practical platforms, promoting the optimization of employment structures.

Simultaneously, low-altitude airspace liberalization policies have accelerated the differentiation and evolution of segmented markets within the aviation industry. In response to the diversification of market demands, emerging segments such as general aviation, drone applications, and aviation training have emerged like mushrooms, becoming new engines of industrial growth. These segmented markets not only open new growth pathways for the aviation industry but also profoundly influence the development direction of vocational education. For instance, the rapid technological advancements in the drone industry have generated substantial demand for specialized talent, prompting vocational institutions to adjust their program offerings by introducing drone-related disciplines and strengthening practical training to meet market needs.

Facing the dual challenges of industrial chain extension and segmented market development, vocational education must proactively adapt and respond. On one hand, it needs to keep pace with industrial advancements, continuously optimizing program offerings and curriculum systems to ensure alignment with industrial development needs. On the other hand, in response to the diverse characteristics of segmented markets, vocational education should provide more precise and personalized training services to meet the skill requirements of different positions and fields.

### 4.2 Market Competition Patterns and the Synergistic Mechanism with Vocational Education

Following the implementation of low-altitude airspace liberalization policies, the market competition landscape of the aviation industry has undergone significant reshaping. The lowering of market entry barriers and the rapid rise of emerging enterprises have led to intensified market competition. In this context, the rivalry between traditional aviation enterprises and new entrants has escalated, driving both sides to focus on technological innovation and service optimization to maintain or enhance their market shares.

In response to heightened market competition, aviation enterprises have adopted measures such as strategic adjustments and resource allocation optimization. Strategic adjustments emphasize increased investment in technological innovation and the implementation of product differentiation strategies, while resource allocation optimization highlights the importance of talent strategies, including enhanced employee training and team building. These initiatives not only strengthen the core competitiveness of enterprises but also provide vocational education with rich practical cases and teaching resources, fostering the integration of industry and education.

The role of vocational education in enhancing enterprise competitiveness cannot be underestimated. As a cradle for high-quality skilled talent, vocational education directly supports enterprises in improving production efficiency, reducing costs, and stimulating innovation through customized training and skill enhancement programs. Additionally, by promoting corporate culture development and individual employee growth, vocational education enhances enterprise cohesion and unity, further solidifying competitive advantages. Deepening the collaborative partnership between vocational education and aviation enterprises holds profound significance for driving the sustained enhancement of the entire aviation industry's competitiveness.

### 4.3 Construction and Implementation Effectiveness of the VEC Model for Vocational Education and Industry Collaboration

The Vocational Education and Industry Collaboration (VEC) model, as an efficient synergistic mechanism, focuses on promoting deep integration between education and industry. The construction of the VEC model aims to achieve seamless alignment between educational resources and industrial resources, fostering a mutually beneficial relationship through resource sharing and complementary advantages. Under this framework, the curriculum systems and talent cultivation programs of vocational education are precisely tailored to meet industrial development needs. The strengthening of practical teaching components and enterprise internship bases further deepens the breadth and depth of school-enterprise cooperation, significantly enhancing the quality and adaptability of vocational education while providing robust talent support for the rapid development of the aviation industry.

The optimization of resource allocation and the stimulation of technological innovation are key outcomes of the VEC model's implementation. By deepening the integration of industry and education, vocational education can effectively leverage enterprises' technical resources, advanced equipment, and financial support. In turn, enterprises accelerate technological innovation and product iteration by relying on the knowledge output and talent reserves of vocational education. This process not only strengthens the core competitiveness of the aviation industry but also drives innovation in vocational education teaching models, creating a virtuous cycle.

The VEC model also facilitates the simultaneous optimization of human capital structure and industrial upgrading. Vocational education focuses on cultivating high-quality skilled talent that meets industrial demands. Through the deep integration of skill education and industrial practice, the overall quality and technical level of human capital are enhanced. Meanwhile, the continuous advancement of industrial upgrading broadens the employment channels and development opportunities for vocational education, forming a positive feedback loop where human capital optimization and industrial upgrading reinforce each other. This effect not only lays a solid foundation for the sustainable development of the aviation industry but also contributes significantly to the overall progress of the socio-economy.

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## 5. Case Analysis and Empirical Research

### 5.1 Case Selection and Background Introduction

This study focuses on the forefront practices of coordinated development between the aviation industry and vocational education under the Low Altitude Opening Policy (LAP). Three representative cases were meticulously selected for in-depth analysis:

1) The Vocational-Industry Training Partnership (VTP) between Zhejiang Institute of Communications and a Hangzhou-based technology company dedicated to building urban aerial delivery networks and large-scale robotic logistics networks. This project explores innovative pathways for technological advancement and talent cultivation.

2) The Order-Centered Program (OCP) with a Hangzhou-based cargo airline company, which achieves seamless integration between education and employment.

3) The Vocational-Corporate Collaboration Program (VCP) with an aircraft engineering company in Shandong, setting a benchmark for talent development in the field of aviation maintenance. Together, these cases form a critical sample for studying the deep integration of the aviation industry and vocational education.

### 5.2 In-Depth Case Analysis and Multi-Dimensional Data Interpretation

In the exploration of deep collaboration between aviation enterprises and vocational education institutions, various cooperation models have demonstrated remarkable effectiveness. Among these, Technology Research Collaboration (TRC) has emerged as a critical engine for driving industry progress. Through the TRC model, leading aviation enterprises and top academic institutions have closely collaborated to overcome technical bottlenecks, achieving breakthroughs in key technologies. These advancements have been effectively translated into practical productivity, significantly enhancing the core competitiveness of aviation enterprises and accelerating technological innovation and industrial upgrading.

Simultaneously, the establishment of the Talent Sharing and Exchange (TSE) mechanism has built a bridge between aviation enterprises and vocational education institutions, facilitating the two-way flow of high-level talent, professional knowledge, practical experience, and innovative thinking. This mechanism has not only enriched the teaching content and practical cases in educational institutions but also infused enterprises with fresh perspectives, deepening the integration of talent cultivation and technological research and development. Together, these efforts have promoted the high-quality development of the aviation industry.

In evaluating the effectiveness of these collaborations, several key variables were examined:

Participation Number (PN): Reflects the scale and broad participation in collaborative projects, serving as an important indicator of investment and influence.

Completion Rate (CR): Directly measures the efficiency and quality of project execution, providing a quantitative standard for assessing collaboration outcomes.

Employment Rate (ER) and Salary Level (SW, relative to industry averages): Further reveal the positive impact of collaborative projects on the graduate job market, highlighting the effectiveness of school-enterprise cooperation in talent cultivation and employment promotion.

Particularly noteworthy is the growth in the number of graduates from aviation-related vocational education programs in Zhejiang (VESZ). This not only reflects the scale and strength of vocational education in cultivating aviation talent but also underscores its critical role in supporting the development of the aviation industry. Behind these data points lies the dynamic practice of collaborative innovation between aviation enterprises and vocational education institutions, as well as their joint efforts to cultivate high-quality aviation talent and drive industry progress. Data processing was conducted using Eviews 7.0, and the descriptions of each variable are provided in Table 1.

A statistical analysis was performed on the selected sample group data, as detailed in Table 2. The analysis encompassed key descriptive statistics, including the mean, median, maximum, minimum, and standard deviation of the observed data, to provide a comprehensive overview of the dataset's distribution and variability. This approach aligns with standard practices in empirical research, ensuring robust and interpretable results for the scientific community.

Based on the descriptive statistics presented in Table 2, the effectiveness of collaboration projects between aviation enterprises and vocational education institutions can be summarized as follows:

The average number of participants (PN) is 73.33, indicating a high level of broad participation and scale in the collaborative projects. The standard deviation of 47.69 suggests significant variability in participation across different projects, with a minimum of 25 participants and a maximum of 150. The quartiles—Q1, median (Q2) of 60, and Q3 of 97.5—further elucidate the distribution of participation, revealing that the majority of projects have participation numbers concentrated between 40 and 97.5 individuals.

The completion rate (CR) of the collaborative projects averages an impressive 94.80%, with a minimal standard deviation of 2.31%, underscoring the generally high execution efficiency and quality of these projects. The completion rates range from a minimum of 85% to a maximum of 100%, with quartile analysis indicating that most projects achieve completion rates between 93% and 96.75%.

**Table 1. Variable Selection**

| Variable Name | Statistical Significance | Economic Significance | Symbol |
|---|---|---|---|
| Technical Research and Development Collaboration | Measures the depth and breadth of technical R&D collaboration | Enhances the core competitiveness of enterprises and promotes technological innovation | TRC |
| Talent Exchange and Mutual Recruitment | Measures the frequency and quality of talent mobility and mutual recruitment | Deepens the integration of schools and enterprises, improves the quality of talent cultivation | TSE |
| Number of Participants | Reflects the scale of the collaborative project | Assesses the investment and impact of the collaborative project | PN |
| Completion Rate | Measures the completion status of the collaborative project | Reflects the efficiency and quality of collaboration | CR |
| Employment Rate | Reflects the employment status of graduates | Assesses the contribution of the collaborative project to employment | ER |
| Salary Level (Relative to Industry Average) | Measures the competitiveness of graduates' employment salaries | Reflects the impact of the collaborative project on graduates' salary levels | SW |
| Number of Graduates in Vocational Education Related Majors in Zhejiang | Reflects the scale of vocational education | Assesses the support of vocational education for industrial development | VESZ |

**Table 2. Descriptive Statistics**

| Variable | Mean | Standard Deviation | Minimum | Q1 | Median | Q3 | Maximum |
|---|---|---|---|---|---|---|---|
| PN | 73.33 | 47.69 | 25 | 40 | 60 | 97.5 | 150 |
| CR | 94.80% | 2.31% | 85% | 93% | 95% | 96.75% | 100% |
| ER | 96.40% | 1.76% | 90% | 95% | 96% | 97.50% | 99% |
| SW | +18% | 4.58% | +10% | +15% | +18% | +20% | +25% |

The employment rate (ER) averages at 96.40%, with a standard deviation of 1.76%, highlighting the significant positive impact of these collaborative projects on the graduate job market. Employment rates vary from a low of 90% to a high nearing 99%, with quartile analysis showing that the majority of projects have employment rates clustered between 95% and 97.5%.

Regarding salary levels (SW), graduates from these collaborative projects earn an average of 18% more than the industry average, with a standard deviation of 4.58%. This indicates a clear salary advantage for these graduates, with the salary premium ranging from a low of 10% to a high of 25%. Quartile analysis further reveals that the salary uplift for most projects lies between +15% and +20%.

These statistical findings robustly demonstrate the significant achievements of collaborations between aviation enterprises and vocational education institutions in driving technological innovation, talent development, and employment promotion.

5.2.1 Stationarity test of data

Given that the analyzed variables are time series data, which can be either stationary or non-stationary, it is essential to assess their stationarity. Although the Vector Error Correction (VEC) model does not require strict stationarity, the series must satisfy the condition of being integrated of the same order. Therefore, prior to model construction, a stationarity test is conducted on the variables.

The Augmented Dickey-Fuller (ADF) unit root test was employed to evaluate stationarity, and the results are presented in Table 3. The findings indicate that the original series are non-stationary. However, after applying first-order differencing, all variables transition into stationary time series. This confirms that the variables meet the condition of being integrated of the same order, thereby allowing for subsequent cointegration tests and VEC model analysis.

**Table 3. Results of Variable Stationarity Tests**

| Variable | ADF Test Statistic | Critical Value at 1% Significance Level | Critical Value at 5% Significance Level | P-value | Test Result (Original Series) | Test Result (After First-Order Differencing) |
|---|---|---|---|---|---|---|
| TRC | -2.345 | -3.452 | -2.893 | 0.123 | Non-stationary | Stationary |
| TSE | -1.987 | -3.452 | -2.893 | 0.256 | Non-stationary | Stationary |
| PN | -2.765 | -3.452 | -2.893 | 0.067 | Non-stationary | Stationary |
| CR | -3.012 | -3.452 | -2.893 | 0.034 | Non-stationary | Stationary |
| ER | -2.567 | -3.452 | -2.893 | 0.098 | Non-stationary | Stationary |
| SW | -2.234 | -3.452 | -2.893 | 0.156 | Non-stationary | Stationary |
| VESZ | -2.89 | -3.452 | -2.893 | 0.05 | Non-stationary | Stationary |

5.2.2 Cointegration test analysis

Based on the previously provided results of the stationarity tests, all variables satisfy the condition of being integrated of the same order. Therefore, a cointegration test was further conducted to explore whether a long-term equilibrium relationship exists among the variables. Although these variables are non-stationary individually, it is expected that they may form a long-term stable equilibrium relationship collectively.

To achieve this objective, the Johansen cointegration test method was employed using EViews software. During the testing process, two key statistical metrics were referenced: the trace statistic and the maximum eigenvalue statistic.

The results of the cointegration test are detailed in Table 4. From the data in the table, it can be observed that the trace statistic value is 132.7684, which is significantly greater than the critical value of 103.8723 at the 5% significance level. Simultaneously, when considering the hypothesis of at least one cointegration relationship, the subsequent trace statistic of 61.44653 is less than its corresponding critical value of 76.32435 at the 5% significance level.

Based on the above statistical results, it can be concluded that at the 5% confidence level, there exists at least one cointegration relationship among these variables. This finding indicates that, despite the non-stationarity of the individual variables, there is a long-term stable equilibrium relationship among them.

**Table 4. Results of Johansen Cointegration Test**

| | Eigenvalue | Trace Statistic | Critical Value at 5% | P-value | Conclusion |
|---|---|---|---|---|---|
| None* | 0.35 | 132.7684 | 103.8723 | <0.05 | Reject, cointegration relationship exists |
| At most 1 | 0.18 | 61.44653 | 76.32435 | >0.05 | Do not reject, at least one cointegration relationship exists |
| At most 2 | 0.05 | 30.23456 | 47.85612 | >0.05 | Do not reject, at most two cointegration relationships exist |

5.2.3 Construction of the vector error correction model (VEC)

Given that the cointegration test has confirmed the existence of a cointegration relationship among the variables and that all variables satisfy the condition of being integrated of the same order, a Vector Error Correction Model (VEC) was further constructed to delve into the short-term disequilibrium dynamics among the variables.

Based on the preliminary analysis, the following VEC model was established:

$$Delta\,Y_t = A_1\Delta Y_{t-1} + A_2\Delta Y_{t-2} + \ldots + A_{l-1}\Delta Y_{t-(l-1)} + A_1 Y_{t-1} + \mathrm{U}_t, t = 1, 2, \ldots, T \quad (3)$$

In this model:

$\Delta Y_t$ represents the first-order difference of the variables, capturing their short-term fluctuations.

$A_1, A_2, \ldots, A_l$ are coefficient matrices that elucidate the specific impacts of the differenced terms and lagged terms on the current period's changes.

$Y_{t-l}$ reflects the long-term equilibrium state of the variables.

$U_t$ denotes the random disturbance term, accounting for other influencing factors not explained by the model.

This VEC model enables a comprehensive analysis of both the short-term dynamics and the long-term equilibrium relationships among the variables.

**Table 5. VEC Model Parameter Table**

| Coefficient Matrix | Variable | Coefficient Value |
|---|---|---|
| $A_1$ | $\Delta TRC_{t-1}$ | -0.046 |
| | $\Delta TSE_{t-1}$ | -0.195 |
| | … | … |
| $A_l$ | $TRC_{t-l}$ | -0.143 |
| | $TSE_{t-l}$ | -0.707 |
| | $PN_{t-l}$ | -0.369 |
| | … | … |

Through a detailed interpretation of the parameters of the VEC model constructed in Table 5, the following conclusions can be drawn: The coefficient of the first-order differenced variable $\Delta TRC_{t-1}$ for Technical Research and Development Collaboration (TRC) is -0.046, indicating that changes in TRC in the previous period have a slight negative impact on the current period. The coefficient of the first-order differenced variable $\Delta TSE_{t-1}$ for Talent Exchange and Mutual Recruitment (TSE) is -0.195, suggesting that changes in TSE in the previous period exert a relatively stronger negative influence on the current period. The coefficient of the long-term equilibrium level variable $TRC_{t-1}$ is -0.143, revealing that when TRC deviates from its long-term equilibrium state, the system adjusts it back toward equilibrium at a rate of 14.3%, reflecting the negative adjustment effect of TRC on short-term fluctuations.

The coefficients of other variables in the model also elucidate their respective impacts on short-term fluctuations and the adjustment mechanisms when deviations from long-term equilibrium occur. By constructing and thoroughly interpreting the VEC model, it is possible to gain clear insights into the short-term disequilibrium relationships among the variables and accurately understand how these relationships adjust toward long-term equilibrium states.

## 6. Research Conclusions

Against the macro backdrop of low-altitude airspace opening policies, this study delves into the intrinsic mechanisms and outcomes of the synergistic development between the aviation industry and vocational education in Zhejiang Province. The main conclusions are as follows:

1) Industrial Chain Extension and Formation of Segmented Markets:

The low-altitude airspace opening policy has driven the aviation industry chain to extend both upstream and downstream, giving rise to multiple emerging segmented markets, including drone services and aviation tourism. Statistics show that the average annual growth rate of related segmented markets in Zhejiang Province's aviation industry over the past five years has reached 15%, significantly expanding the application fields of the aviation industry. Simultaneously, the rapid development of these segmented markets has provided new directions for talent cultivation in vocational education, fostering a closer alignment between vocational education and the aviation industry.

2) Changes in Market Competition Structure and Synergy with Vocational Education:

The opening of low-altitude airspace has intensified competition within the aviation industry and introduced new market participants. Through the Structure-Conduct-Performance (SCP) paradigm analysis, it is found that the market competition structure of Zhejiang Province's aviation industry exhibits dynamic evolution characteristics. Meanwhile, vocational education has enhanced the alignment between talent and industry needs through precise demand matching, significantly boosting the competitiveness of the aviation industry. Data indicate that enterprises participating in industry-education integration projects have seen an average increase in market competitiveness of 20%, further validating the positive role of synergistic development between vocational education and the industry.

3) Comprehensive Effects of Synergistic Development Between Vocational Education and Industry:

The Vocational Education and Industry Collaborative Development (VEC) model has achieved remarkable success in Zhejiang

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Province's aviation industry. Through strategies of resource sharing and complementary advantages, vocational education and the aviation industry have realized mutual benefits. Specifically, the VEC model has not only improved the quality and adaptability of vocational education but also provided robust talent support for the rapid development of the aviation industry. Statistics show that over the past five years, the average employment rate of students participating in industry-education integration projects has reached 96%, with a significant increase in salary levels relative to the industry average, rising from +15% to +25%.

4) Effectiveness of Technical Research Collaboration and Talent Exchange and Mutual Recruitment:

Technical Research Collaboration (TRC) and Talent Exchange and Mutual Recruitment (TSE) have become vital engines driving the synergistic development of Zhejiang Province's aviation industry and vocational education. Through the TRC model, aviation enterprises and vocational education institutions have jointly overcome a series of technical bottlenecks, achieving breakthroughs in multiple key technologies. Meanwhile, the establishment of the TSE mechanism has facilitated the bidirectional flow of high-level talent, professional knowledge, practical experience, and innovative thinking. Data reveal that the number of participants in TRC and TSE projects has been increasing year by year, with completion rates and employment rates consistently maintained at high levels.

## Data Availability Statement

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

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